

Customer No.	026418	
Attorney's Docket No.:	GK-ZEI-3126 / 500343.20127	
U.S. Application No.:	09/856222	
International Application No.:	PCT/EP00/09199	
International Filing Date:	SEPTEMBER 20, 2000	20 SEPTEMBER 2000
Priority Date Claimed:	SEPTEMBER 29, 1999	29 SEPTEMBER 1999
Title of Invention:	MICROSCOPE, ESPECIALLY MICROSCOPE USED FOR INSPECTION IN SEMICONDUCTOR MANUFACTURE	
Applicant(s) for (DO/EO/US):	Thomas ENGEL, Wolfgang HARNISCH and Roland SCHELER	

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

- ☒ 1. This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
☐ 2. This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
☐ 3. This express request to begin national examination procedures [35 U.S.C. 371 (f)] at any time rather than delay examination until the expiration of the applicable time limit set forth in 35 U.S.C. 371(b) and PCT Articles 22 and 41.
☐ 4. A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
☒ 5. A copy of the International Application as filed [35 U.S.C. 371(c)(2)]
a) ☐ is transmitted herewith (required only if not transmitted by the International Bureau)
b) ☐ has been transmitted by the International Bureau
c) ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
☐ 6. A translation of the International Application into English [35 U.S.C. 371(c)(2)] **TO FOLLOW**
☐ 7. Amendments to the claims of the International Application under PCT Article 19 [35 U.S.C. 371(c)(3)]
a) ☐ are transmitted herewith (required only if not transmitted by the International Bureau)
b) ☐ have been transmitted by the International Bureau
c) ☐ have not been made; however, the time limit for making such amendments has **NOT** expired.
d) ☐ have not been made and will not be made
☐ 8. A translation of the amendments to the claims under PCT Article 19 [35 U.S.C. 371(c)(3)]
☐ 9. An Oath or declaration of the inventor(s) [35 U.S.C. 371(c)(4)] **Executed Decl. POA TO FOLLOW**
☐ 10. A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 [35 U.S.C. 371(c)(5)]

Items 11. to 16. Below concern other document(s) or information included:

- ☐ 11. An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98
☐ 12. An Assignment document for recording. A separate cover sheet (PTO-1619A) in compliance with 37 CFR 3.28 and 3.31 is included.
☐ 13. ☐ A **FIRST** preliminary amendment
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment
☐ 14. A **substitute specification**
☐ 15. A change of power of attorney and/or address letter
☒ 16. (other items or information) **PCT/RO/101 and Publication No. WO 01/23940 5APR01 and Search Report (PCT/ISA/210 dated 6MAR01)**

THIS APPLICATION IS FILED IN THE GERMAN LANGUAGE

EXPRESS MAIL No.: **EL 645 878 625 US**

Deposited: **May 18, 2001**

I hereby certify that this correspondence is being deposited with the United States Postal Service Express mail under 37 CFR 1.10 on the date indicated above and is addressed to: BOX PCT, Commissioner for Patents, Washington, DC 20231.


/Ruth Montalvo Date: **May 18, 2001**

[X] 17. The following fees are submitted:

BASIC NATIONAL FEE [37 CFR 1.492(a)(1)-(5)]

JC18 Rec'd PCT/PTO 1 8 MAY 2001

[X] Search Report has been prepared by the EPO or JPO..... \$ 860.00

[] International preliminary examination fee paid to USPTO [37 CFR 1.482]..... \$ 690.00

[] No International preliminary examination fee paid to USPTO [37 CFR 1.482] but International search fee paid to USPTO [37 CFR 1.445(a)(2)]..... \$ 710.00

[] Neither International preliminary examination fee [37 CFR 1.482] nor International search fee [37 CFR 1.445(a)(2)] paid to USPTO..... \$ 1,000.00

[] International preliminary examination fee paid to USPTO [37 CFR 1.482] and all claims satisfied provisions of PCT Article 33(1)-(4)..... \$ 100.00

ENTER APPROPRIATE BASIC FEE AMOUNT:

\$860.00

Claims

Number

Number

Rate

Total Claims

5

-20

x \$ 18. =

Indep. Claims

1

-03

x \$ 80. =

[] Multiple Dependent Claim(s) (if applicable)

+ \$ 270. =

TOTAL OF ABOVE CALCULATIONS:

\$860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date [37 CFR 1.492(e)]

TOTAL OF ABOVE CALCULATIONS:

\$860.00

Applicant claims Small Entity Status [See 37 CFR 1.27] Reduction by 1/2 for filing by small entity

SUBTOTAL:

\$860.00

Processing fee of \$130.00 for furnishing the English Translation later than [] 20 [] 30 months from the earliest claimed priority date [37 CFR 1.492(f)]

TOTAL NATIONAL FEE:

\$860.00

Fee for recording the enclosed assignment [37 CFR 1.21(h)] The assignment must be accompanied by an appropriate cover sheet (PTO-1595) [37 CFR 3.28, 3.31]. \$ 40.00 per property +

TOTAL FEE(S):

\$860.00

AMOUNTS TO BE
REFUNDED OR CHARGED

REFUNDED
CHARGED

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\$

[X] Check in the amount of \$ 860.00 to cover the above fees is enclosed. (The Commissioner is hereby authorized to charge any additional fees required with this submission or to credit any overpayment to Deposit Account No: 50-1529.)

NOTE: Where an appropriate time limit under 36 CFR 1.494 or 1.495 has not been met, a petition to revive [37 CFR 1.137(a) or (b)] must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Name (Tel. (212) 521-5400)

Signature

25,116

Reg. No.

May 18, 2001

Date

09/856222

EXPRESS MAIL mailing label No. EL 915 669 961 US Date of Deposit August 20, 2001

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner for Patents, Washington, D.C. 20231.

Ruth Montalvo

Date _____

Docket No.:GK-ZEI-3126/500343.20127

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Thomas ENGEL, Wolfgang HARNISCH and Roland SCHELER
Serial No.:	09/856,222
Filed:	May 18, 2001
For:	MICROSCOPE, ESPECIALLY MICROSCOPE USED FOR INSPECTION IN SEMICONDUCTOR MANUFACTURE

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to receipt of a first Office Action in the above-identified application, please amend this application as follows:

IN THE SPECIFICATION

Cancel the present specification and substitute therefor the enclosed substitute specification.

IN THE CLAIMS

Page 3 line 1, change "PATENT CLAIMS" to --What is claimed is:--.

Cancel claims 1-5 and add new claims 6-13, reading as follows:

--6. (new) A microscope, especially for inspection during semiconductor manufacture comprising:

a pulsed laser for illumination, said laser being in the UV range; and

at least one rotating diffusion disk is arranged behind the laser for the homogenization of the illumination.

7. (new) The microscope according to claim 6, including two diffusion disks rotating in opposite directions arranged directly or indirectly behind each other in the illumination ray path.

8. (new) The microscope according to claim 6, wherein the diffusion disk is either of a granulated or of a holographically produced design.

9. (new) The microscope according to claim 6, with a rotation speed of at least such a magnitude that a rotation by at least one grain size and/or the resolution limit of a holographically generated structure or by the length of a structure takes place between two laser pulses.

10. (new) The microscope according to claim 6, with an illumination laser wavelength which essentially corresponds to the illumination wavelength during the manufacture of semiconductors.

11. (new) The microscope according to claim 10, wherein the illumination wavelength is in the range of 193nm or 248nm or 266nm or 366nm, all with a tolerance of +/-2nm.

12. (new) An inspection device for use in semiconductor manufacture comprising:
a laser module with pulsed UV laser;

a transmitter port;
a microscope having at least one rotating diffusion disk arranged behind the laser for the homogenization of the illumination;
a scanning table;
a CCD camera;
a screen; and
a microscope controller.

13. (new) In an inspection device for use in semiconductor manufacture, having a microscope, an improvement comprising that said laser is a pulsed laser in the UV range and at least one rotating diffusion disk is arranged behind the laser for the homogenization of the illumination.--

IN THE ABSTRACT OF THE DISCLOSURE

Cancel the present Abstract of the Disclosure and substitute therefor the enclosed Abstract of the Disclosure which is attached to the substitute specification.

REMARKS

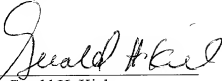
Claims 1-5 have been cancelled and new claims 6-13 have been added.
The amendments to the claims have been made only to improve the form of the claims for examination purposes.

The specification and abstract have been amended to conform it to U.S. format.

An early and favorable action on the merits is respectfully requested.

Respectfully submitted,

By:


Gerald H. Kiel
Reg. No. 25,116

August 20, 2001
REED SMITH LLP
375 Park Avenue
New York, NY 10152-1799
GHK:jl
Enc.: Substitute Specification
Abstract of the Disclosure

Rec'd PCT/PTO 20 AUG 2001
09/856222

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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SUBSTITUTE
SPECIFICATION
And
ABSTRACT

FILE NO. GK-ZEI-3126/500343.20127

MICROSCOPE, ESPECIALLY MICROSCOPE USED FOR INSPECTION IN
SEMICONDUCTOR MANUFACTURE

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CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority of International Application
No. PCT/EP00/09199, filed September 20, 2000 and German Application
10 No. 199 46 594.0, filed September 29, 1999, the complete disclosures of which are
hereby incorporated by reference.

BACKGROUND OF THE INVENTION

15 Field of the Invention

The invention is directed to the coupling of pulsed laser radiation into
a microscope, especially a microscope used for the quality control and classification
of defects of masks for the manufacture of semiconductors.

20 SUMMARY OF THE INVENTION

In accordance with the invention, a microscope, especially for use
during inspection in semiconductor manufacture comprising a pulsed laser for
illumination, the laser being preferably in the UV range. The microscope includes
at least one rotating diffusion disk which is arranged behind the laser for the
25 homogenization of the illumination

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

30 Figure 1 shows an overall diagrammatic view of an inspection device
using a microscope in accordance with the invention;

Figure 2a shows a diagram of a coupling unit for coupling the laser
beam into the microscope; and

Figure 2b is an additional view showing the coupling of the laser beam into the microscope.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Advantageously, a number of laser pulses are applied to the object to be examined while one image is taken. During this, intensity modulations of the laser profile of up to 40% can occur within one pulse or over a small number of pulses, which affects the evaluation.

Figure 1 shows an overall diagrammatic view of an inspection device consisting of a laser module LM with a pulsed UV laser, a transmitter port UP, a microscope MI with an objective O and a scanning table ST, a CCD camera KA, a screen BS and a microscope controller MC.

Figure 2a and 2b show a coupling unit UP for coupling the laser beam into the microscope MI.

The laser light reaches a first rotating diffusion disk S1 via reflecting mirrors U1, U2 and then a second rotating diffusion disk S2 preferably rotating in the opposite direction as well as the microscope ray path (not shown) via a lens for beam expansion and an aperture B and the input E in Figure 1 and illuminates the object to be examined.

The laser profile is smoothed out by means of the at least one diffusion disk.

The diffusion disk rotates at a speed which is relatively low when compared to the spacing of two laser pulses.

This means that the diffusion disk is practically not moving for the duration of a laser pulse of, for example, 10ns, but also that it moves a bit further in the space of time between two laser pulses (for a repeating frequency of, for example, 200Hz) before the next laser pulse occurs.

This has the advantage of averaging out the granularity of the diffusion disk and furthermore that the granularity caused by the coherence of the laser radiation (speckle) is also averaged out.

This means that noise is reduced and the image contrast is increased and that therefore image quality is improved.

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While the foregoing description and drawings represent the present invention, it will be obvious to those skilled in the art that various changes may be made therein without departing from the true spirit and scope of the present invention.

ABSTRACT OF THE DISCLOSURE

A microscope, especially a microscope that is used for inspection in semiconductor manufacture is disclosed. The microscope comprises a pulsed laser for the purpose of illumination, preferably in the UV range. At least one rotating diffusion disk is disposed downstream of the laser so as to homogenize the illumination. Preferably, two rotating diffusion disks of opposite rotational sense are disposed in the illumination beam path either directly or indirectly one behind the other.

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09/856,222 and Abstract #4

FILE NO. GK-ZEI-3126/500343.20127

MICROSCOPE, ESPECIALLY MICROSCOPE USED FOR INSPECTION IN
SEMICONDUCTOR MANUFACTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority of International Application
No. PCT/EP00/09199, filed September 20, 2000 and German Application
No. 199 46 594.0, filed September 29, 1999, the complete disclosures of which are hereby
incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention is directed to the coupling of pulsed laser radiation into a microscope, especially a microscope used for the quality control and classification of defects of masks for the manufacture of semiconductors.

SUMMARY OF THE INVENTION

In accordance with the invention, a microscope, especially for use during inspection in semiconductor manufacture comprising a pulsed laser for illumination, the laser being preferably in the UV range. The microscope includes at least one rotating diffusion disk which is arranged behind the laser for the homogenization of the illumination

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Figure 1 shows an overall diagrammatic view of an inspection device using a microscope in accordance with the invention;

Figure 2a shows a diagram of a coupling unit for coupling the laser beam into the microscope; and

Figure 2b is an additional view showing the coupling of the laser beam into the microscope.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Advantageously, a number of laser pulses are applied to the object to be examined while one image is taken. During this, intensity modulations of the laser profile of up to 40% can occur within one pulse or over a small number of pulses, which affects the evaluation.

Figure 1 shows an overall diagrammatic view of an inspection device consisting of a laser module LM with a pulsed UV laser, a transmitter port UP, a microscope MI with an objective O and a scanning table ST, a CCD camera KA, a screen BS and a microscope controller MC.

Figure 2a and 2b show a coupling unit UP for coupling the laser beam into the microscope MI.

The laser light reaches a first rotating diffusion disk S1 via reflecting mirrors U1, U2 and then a second rotating diffusion disk S2 preferably rotating in the opposite direction as well as the microscope ray path (not shown) via a lens for beam expansion and an aperture B and the input E in Figure 1 and illuminates the object to be examined.

The laser profile is smoothed out by means of the at least one diffusion disk.

The diffusion disk rotates at a speed which is relatively low when compared to the spacing of two laser pulses.

This means that the diffusion disk is practically not moving for the duration of a laser pulse of, for example, 10ns, but also that it moves a bit further in the space of time between two laser pulses (for a repeating frequency of, for example, 200Hz) before the next laser pulse occurs.

This has the advantage of averaging out the granularity of the diffusion disk and furthermore that the granularity caused by the coherence of the laser radiation (speckle) is also averaged out.

This means that noise is reduced and the image contrast is increased and that therefore image quality is improved.

For this, the magnitude of the rotating speed of the diffusion disk can lie in the easily realized range of approximately 1 rotation per second (a speed in the range of cm/s), so

ABSTRACT OF THE DISCLOSURE

5 [The invention relates to] A microscope, especially a microscope
that is used for inspection in semiconductor manufacture **is disclosed**. The
10 [invention] microscope comprises a pulsed laser for the purpose of illumination,
preferably in the UV range. At least one rotating diffusion disk is disposed
downstream of the laser so as to homogenize the illumination. Preferably, two
rotating diffusion disks of opposite rotational sense are disposed in the illumination
beam path either directly or indirectly one behind the other.

FILE NO. GK-ZEI-3126/500343.20127

MICROSCOPE, ESPECIALLY MICROSCOPE USED FOR INSPECTION IN
SEMICONDUCTOR MANUFACTURE

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The invention is directed to the coupling of pulsed laser radiation into a microscope, especially a microscope used for the quality control and classification of defects of masks for the manufacture of semiconductors.

Advantageously, a number of laser pulses are applied to the object to be examined while one image is taken. During this, intensity modulations of the laser profile of up to 40% can occur within one pulse or over a small number of pulses, which affects the evaluation.

Figure 1 shows an overall diagrammatic view of an inspection device consisting of a laser module LM with a pulsed UV laser, a transmitter port UP, a microscope MI with an objective O and a scanning table ST, a CCD camera KA, a screen BS and a microscope controller MC.

Figure 2a and 2b show a coupling unit UP for coupling the laser beam into the microscope MI.

The laser light reaches a first rotating diffusion disk S1 via reflecting mirrors U1, U2 and then a second rotating diffusion disk S2 preferably rotating in the opposite direction as well as the microscope ray path (not shown) via a lens for beam expansion and an aperture B and the input E in Figure 1 and illuminates the object to be examined.

The laser profile is smoothed out by means of the at least one diffusion disk.

The diffusion disk rotates at a speed which is relatively low when compared to the spacing of two laser pulses.

This means that the diffusion disk is practically not moving for the duration of a laser pulse of, for example, 10ns, but also that it moves a bit further in the space of time between two laser pulses (for a repeating frequency of, for example, 200Hz) before the next laser pulse occurs.

This has the advantage of averaging out the granularity of the diffusion disk and furthermore that the granularity caused by the coherence of the laser radiation (speckle) is also averaged out.

5 This means that noise is reduced and an the image contrast is increased and that therefore image quality is improved.

For this, the magnitude of the rotating speed of the diffusion disk can lie in the easily realized range of approximately 1 rotation per second (a speed in the range of cm/s), so that for an assumed grain size of 0.1mm a displacement by at least the size of one grain takes place between two pulses.

10 The homogenizing effect is reinforced by a second diffusion disk rotating in the opposite direction.

Besides granulated diffusion disks (made by etching or abrasive blasting), holographic disks can also be used.

15 CGHs (computer-generated holograms) can also be used for homogenization.

PATENT CLAIMS

1. Microscope, especially for the inspection in semiconductor manufacture, with a pulsed laser for illumination, preferably in the UV range, wherein at least one rotating diffusion disk is arranged behind the laser for the homogenization of the illumination.
2. Microscope according to claim 1, with two diffusion disks rotating in opposite directions arranged directly or indirectly behind each other in the illumination ray path.
3. Microscope according to one of the preceding claims, wherein the diffusion disk is either of a granulated or of a holographically produced design.
4. Microscope according to one of the preceding claims, with a rotation speed of at least such a magnitude that a rotation by at least one grain size and/or the resolution limit of a holographically generated structure or by the length of a structure takes place between two laser pulses.
5. Microscope according to one of the preceding claims, with an illumination laser wavelength which essentially corresponds to the illumination wavelength during the manufacture of semiconductors, preferably in the range of 193nm or 248nm or 266nm or 366nm, all with a tolerance of $\pm 2\text{nm}$.

ABSTRACT

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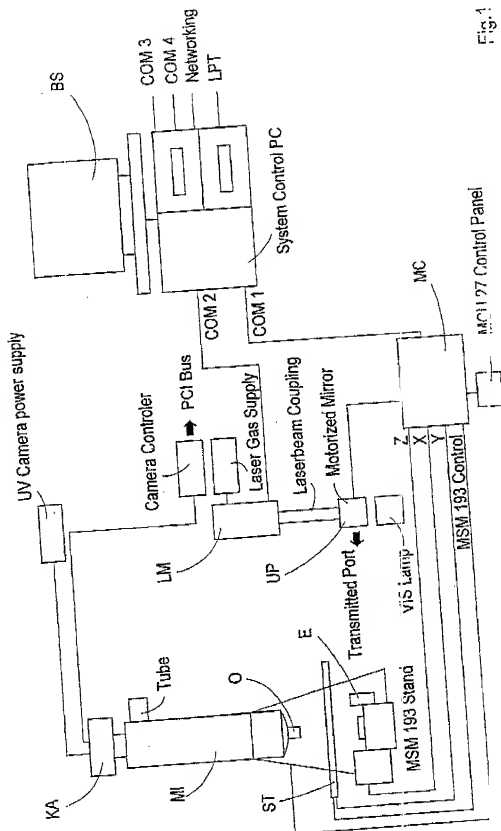
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7. 2. 1.



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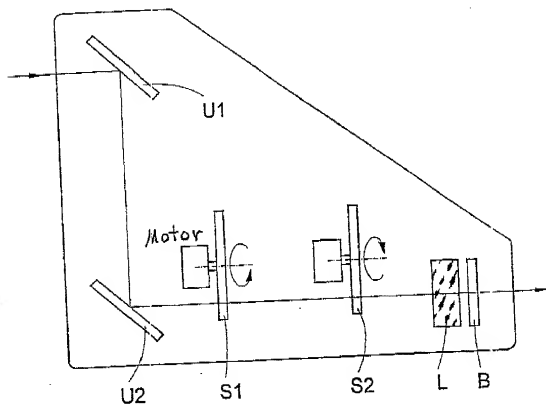


Fig. 2a

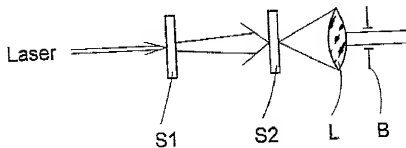


Fig. 2b

#3

UNITED STATES OF AMERICA
COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

FILE NO. GK-ZEI-3126
50343.20127

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MICROSCOPE, ESPECIALLY MICROSCOPE USED FOR INSPECTION IN
SEMICONDUCTOR MANUFACTURE

The specification of which

- ☐ is attached hereto.
☒ was filed on May 18, 2001 as United States patent application Serial Number 09/856,222.
☒ was filed on September 20, 2000 as PCT international patent application No. PCT/EP00/09199 and was amended on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to be material to patentability in accordance with Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. § 119
Germany	199 46 594.0	29 September 1999	YES <u>x</u> NO _____
			YES _____ NO _____

I hereby appoint REED SMITH LLP and the members of the firm: Lloyd McAulay, Reg. No. 20,423; Jules E. Goldberg, Reg. No. 24,408; Gerald H. Kiel, Reg. No. 25,116; Eugene LeDonne, Reg. No. 35,930; Stephen Chin, Reg. No. 39,938; Arthur Dresner, Reg. No. 24,403; Daniel Lent, Reg. No. 44,867; and Samir R. Patel, Reg. No. 44,998 as attorneys with full power of substitution and revocation to prosecute all business in the Patent & Trademark Office connected therewith and to receive all correspondence.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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FULL NAME OF SECOND INVENTOR (IF ANY) Wolfgang HARNISCH	INVENTOR'S SIGNATURE <i>Wolfgang Harnisch</i>	DATE 07/23/01
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COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION (continued)		File No. GK-ZEI-3126/ 500343.20127	
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POST OFFICE ADDRESS		COUNTRY OF CITIZENSHIP	
FULL NAME OF FIFTH INVENTOR (IF ANY)		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
POST OFFICE ADDRESS		COUNTRY OF CITIZENSHIP	
FULL NAME OF SIXTH JOINT INVENTOR (IF ANY)		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
POST OFFICE ADDRESS		COUNTRY OF CITIZENSHIP	
FULL NAME OF SEVENTH JOINT INVENTOR (IF ANY)		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
POST OFFICE ADDRESS		COUNTRY OF CITIZENSHIP	
FULL NAME OF EIGHTH JOINT INVENTOR (IF ANY)		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
POST OFFICE ADDRESS		COUNTRY OF CITIZENSHIP	
FULL NAME OF NINTH JOINT INVENTOR (IF ANY)		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
POST OFFICE ADDRESS		COUNTRY OF CITIZENSHIP	